US010695253B2

(12) **United States Patent**
Patel

(10) **Patent No.: US 10,695,253 B2**
(45) **Date of Patent: Jun. 30, 2020**

(54) **VESTIBULAR OPTIMIZER DEVICES, SYSTEMS, AND METHODS**

(71) Applicant: **Milap N. Patel**, Savannah, GA (US)

(72) Inventor: **Milap N. Patel**, Savannah, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1040 days.

(21) Appl. No.: **15/140,895**

(22) Filed: **Apr. 28, 2016**

(65) **Prior Publication Data**

US 2017/0312160 A1 Nov. 2, 2017

(51) **Int. Cl.**
A61H 1/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61H 1/001*** (2013.01); *A61H 2201/164* (2013.01); *A61H 2201/1607* (2013.01); *A61H 2201/1623* (2013.01); *A61H 2201/1635* (2013.01); *A61H 2201/1671* (2013.01)

(58) **Field of Classification Search**
CPC A61H 1/001; A61H 1/003; A61H 2201/1607; A61H 2201/1623; A61H 2201/1635; A61H 2201/164; A61H 2201/1671; A61H 2001/0203; A61B 5/4863; A47C 1/00; A47C 1/04; A61G 15/00; A61G 15/007; A61G 5/00; A61G 13/00; A61G 13/009; A61G 13/12
USPC 601/15
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,558,143 A * 6/1951 Lauterbach A61G 15/02 297/69
5,303,715 A 4/1994 Nashner et al.
6,656,137 B1 * 12/2003 Tyldsley A61M 21/00 434/185
6,796,947 B2 9/2004 Watt et al.
6,800,062 B2 * 10/2004 Epley A61B 5/11 600/558

(Continued)

FOREIGN PATENT DOCUMENTS

CN	2178101	9/1994
CN	103784292	5/2014
WO	WO2014102617	7/2014

OTHER PUBLICATIONS

"Vestibular Testing," Timothy C. Hain, MD, "American Hearing Research Foundation," published Sep. 2012, pp. 1-9, retrieved Jan. 12, 2016, http://american-hearing.org/disorders/vestibular-testing/.

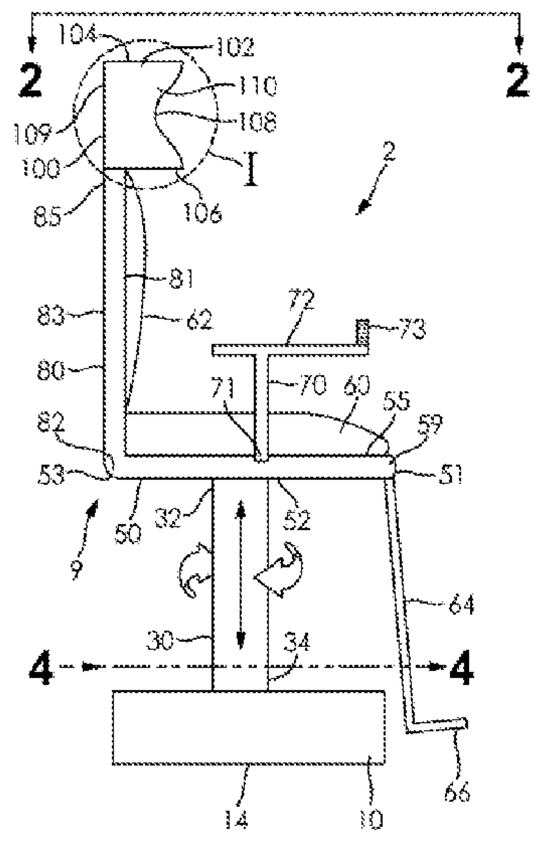
(Continued)

Primary Examiner — Bradley H Philips
Assistant Examiner — Vincent D Hoang
(74) *Attorney, Agent, or Firm* — Buchanan Van Tuinen LLC

(57) **ABSTRACT**

The technical description relates to a vestibular optimizer device configured to administer vestibular stimulation to a subject having a head. An example vestibular optimizer device includes a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, having a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements. It also includes a head engaging member attached to the back of the chair and configured to engage the head of the subject, the head engaging member adapted to move in a second pattern of movements.

15 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,651,224	B2	1/2010	Wood et al.	
7,856,275	B1	12/2010	Paul et al.	
8,355,788	B2	1/2013	Mechlenburg et al.	
8,702,631	B2	4/2014	Maher	
9,167,998	B2	10/2015	Crane	
9,198,571	B2	12/2015	Kiderman et al.	
9,995,940	B2 *	6/2018	Tseng	G02B 27/0176
2004/0097839	A1	5/2004	Epley	
2004/0189079	A1 *	9/2004	Naganuma	A61B 5/00 297/464
2006/0235331	A1	10/2006	Kiderman	
2009/0326604	A1	12/2009	Tyler et al.	
2010/0036289	A1	2/2010	White et al.	
2013/0303939	A1	11/2013	Karmali et al.	
2014/0046231	A1	2/2014	Barlow et al.	
2014/0087340	A1 *	3/2014	Maher	A61B 5/11 434/247
2015/0305509	A1	10/2015	Verdier et al.	
2016/0007849	A1 *	1/2016	Krueger	A61B 3/113 600/301
2016/0213551	A1 *	7/2016	Budagher	A61H 5/00

OTHER PUBLICATIONS

"Rotary chair offers more concise diagnosis for TBI patients," Thomas Brennan, JDNews.com, published May 5, 2014, pp. 1-4, retrieved Jan. 12, 2016, http://www.jdnews.com/20140505/rotary-chair-offers-more-concise-diagnosis-for-tbi-patients/305059887?page=0.

"Chronic Subjective Dizziness," Jeffrey P. Staab, MD, MS, Continuum Lifelong Learning Neurol 2012; 18(5): 1118-1141.

"Diagnostic Criteria for Persistent Postural-Perceptual Dizziness (PPPD): Consensus document of the Committee for he Classification of Vestibular Disorders of the Barany Society," Jeffrey R Staab, MD, MS, et al., pp. 1-45.

"System 2000 Auto-Traverse Rotational Chair," Micromedical Technologies, pp. 1-2, retrieved Jan. 12, 2016, http://www.micromedical.com/Products/Rotational-Chairs/System-2000-Auto-Traverse-Rotational-Chair.

"System 2000 Comprehensive Rotational Chair," Micromedical Technologies, pp. 1-2, retrieved Jan. 12, 2016, http://www.micromedical.com/Products/Rotational-Chairs/System-2000-Comprehensive-Rotational-Chair.

"System 2000 Reclining Rotational Chair," Micromedical Technologies, pp. 1-2, retrieved Jan. 12, 2016, http://www.micromedical.com/Products/Rotational-Chairs/System-2000-Reclining-Rotational-Chair.

"System 2000 Auto Traverse Rotational Vestibular Chair," Micromedical Technologies, pp. 1-6, published Mar. 2014, retrieved Jan. 12, 2016.

"System 2000 Reclining Rotational Vestibular Chair," Micromedical Technologies, pp. 1-4, published Mar. 2014, retrieved Jan. 12, 2016.

* cited by examiner

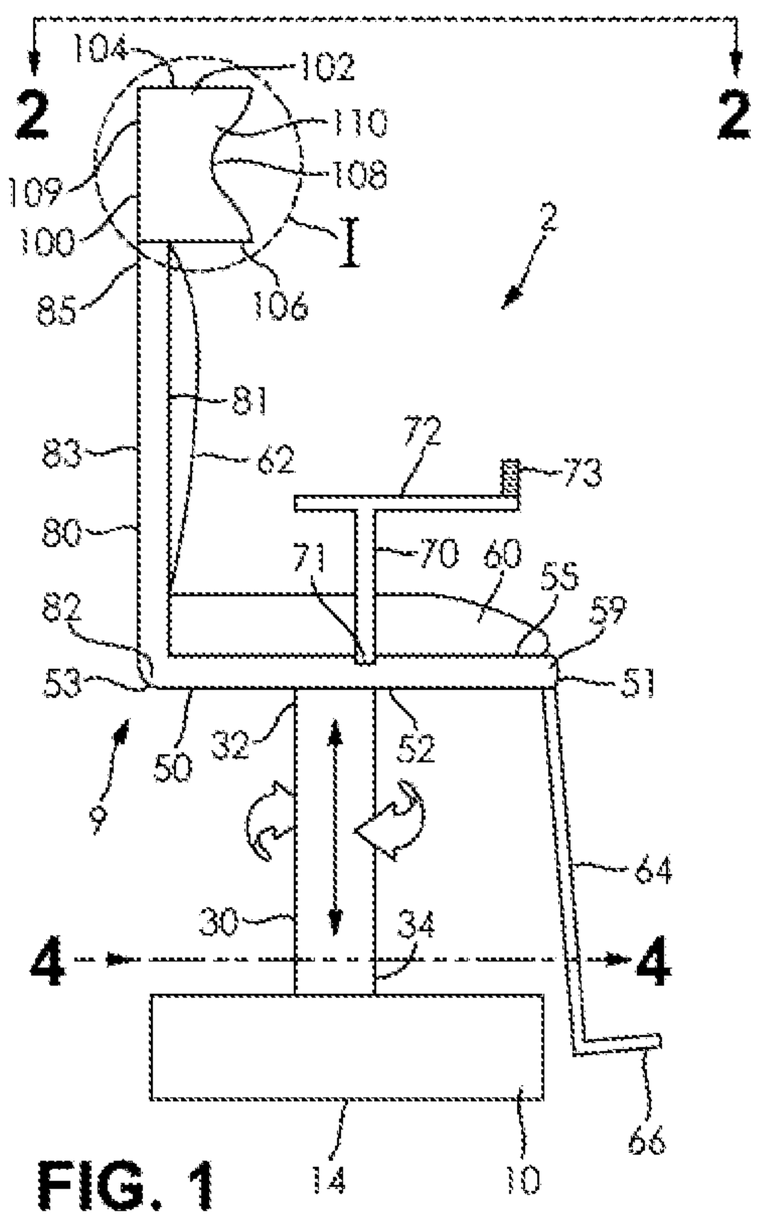

104
102
2
2
110
108
109
100
I
85
106
2
81
83
62
72
73
80
71
70
60
55
59
82
53
51
50
32
52
9
64
30
34
4
4
66
14
10

FIG. 1

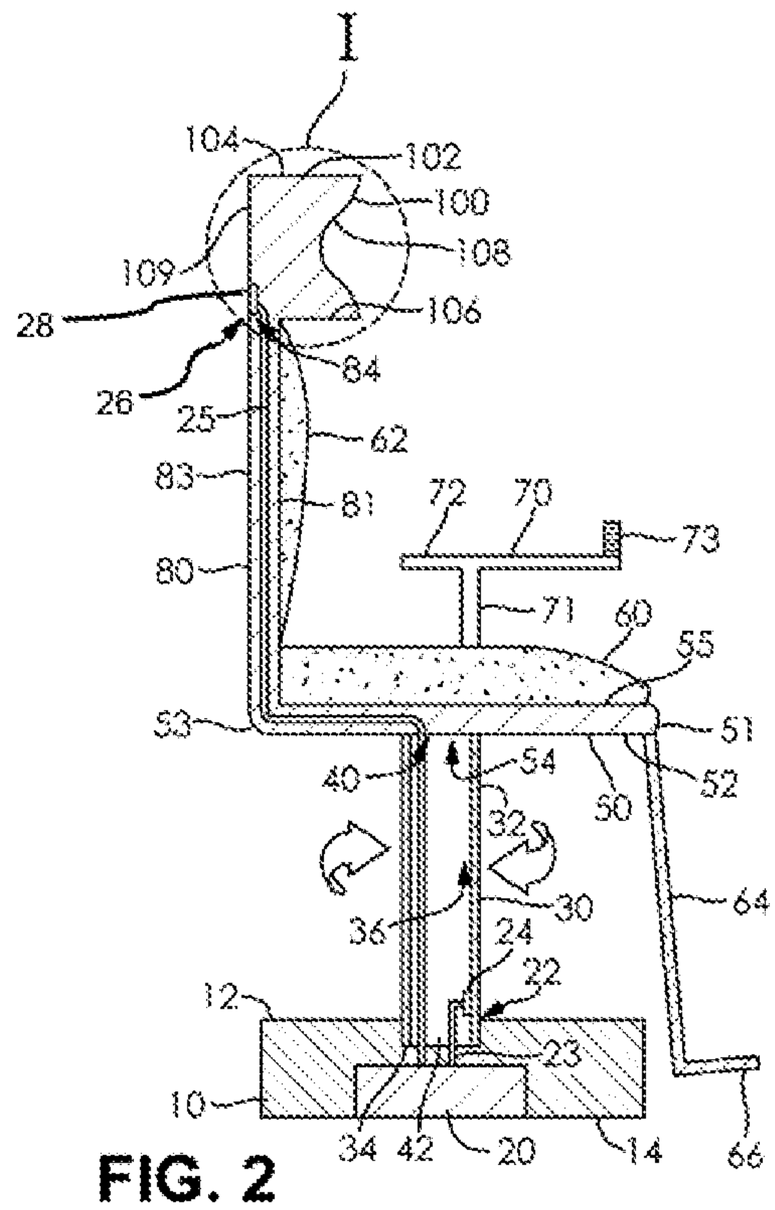

I
104
102
100
108
109
106
28
84
26
25
62
83
81
72
70
73
80
71
60
55
53
51
40
54
52
50
32
30
64
36
24
22
12
23
10
34
42
20
14
66

FIG. 2

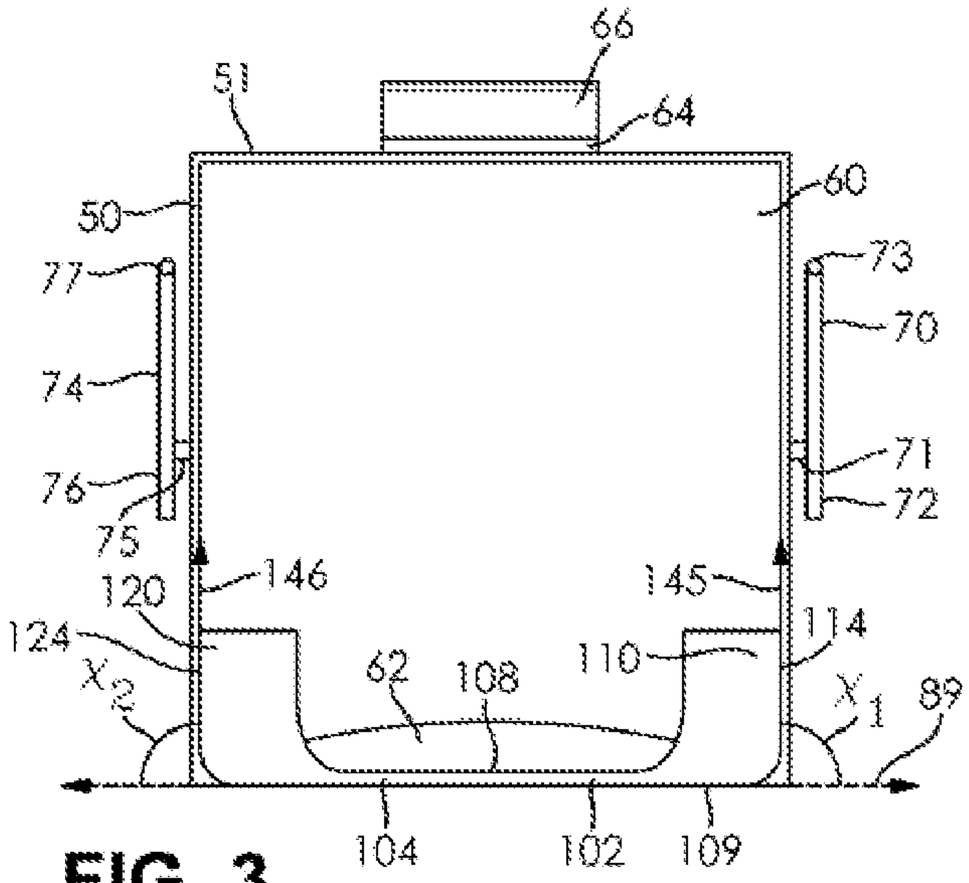

66
51
64
60
50
73
77
70
74
71
76
72
75
146
145
120
114
124
62
108
110
X_2
X_1
89
104
102
109

FIG. 3

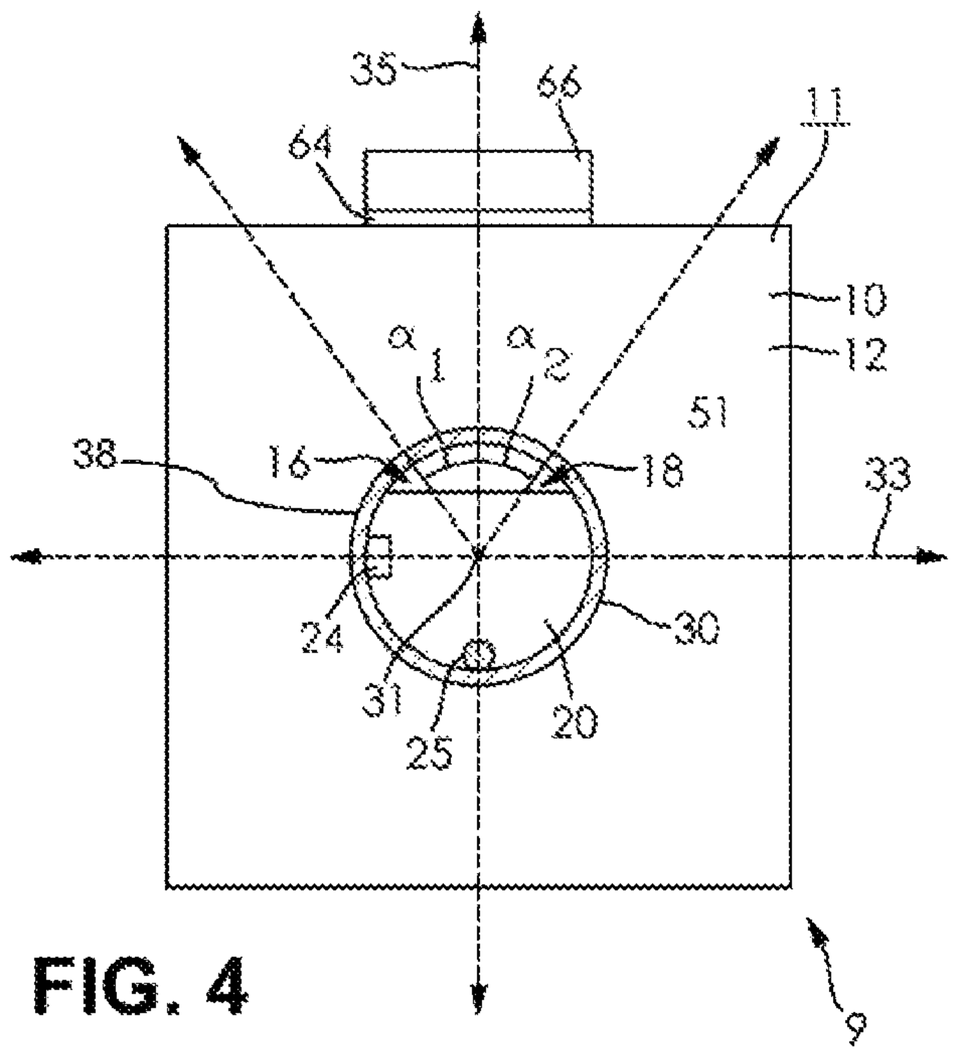

35
66
64
11
10
12
α_1
α_2
51
38
16
18
33
24
30
31
20
25
9

FIG. 4

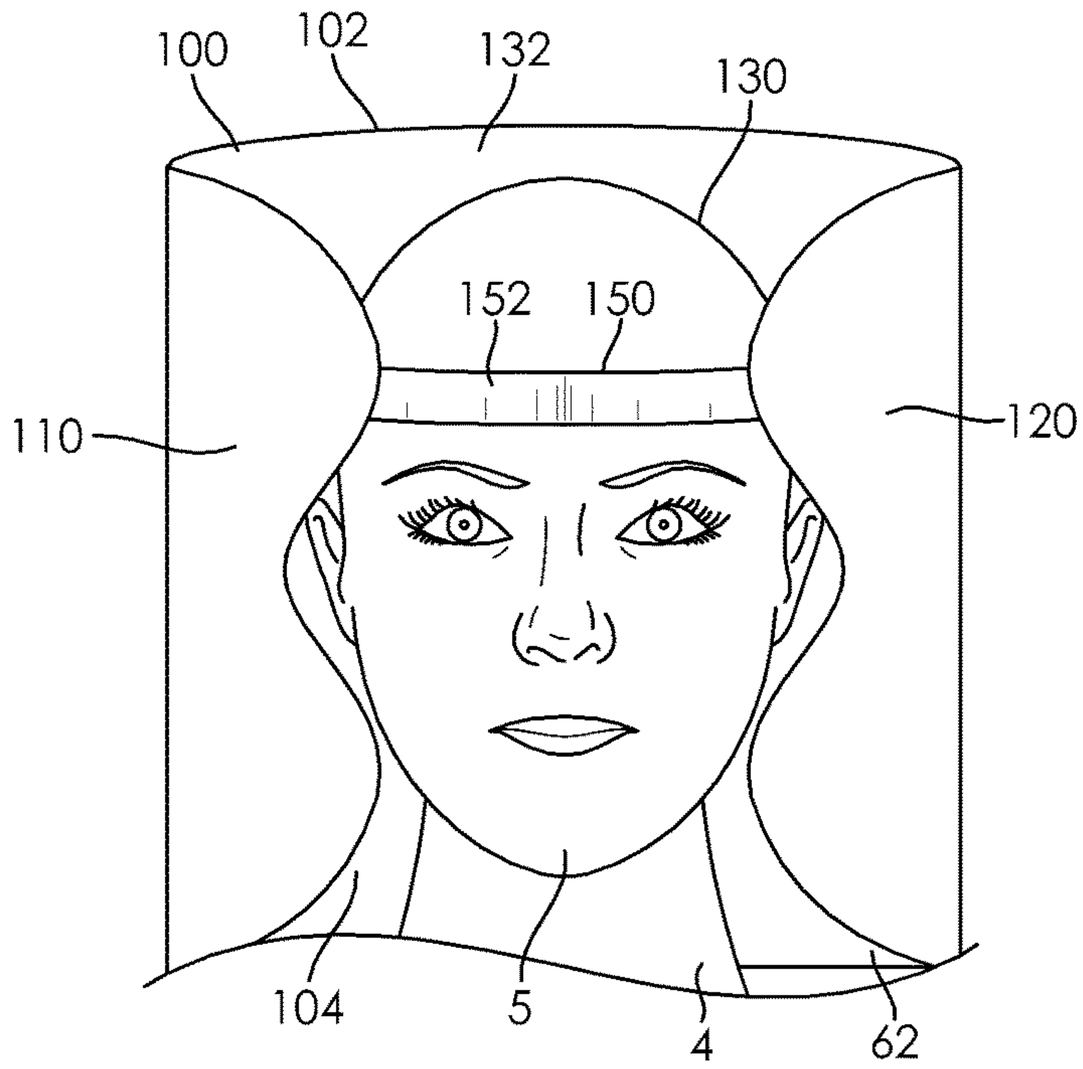


FIG. 5

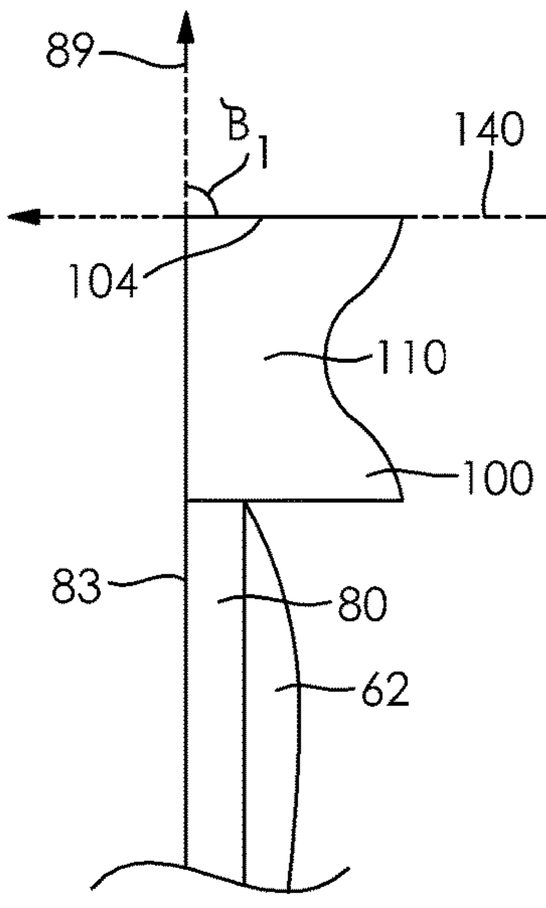


FIG. 6

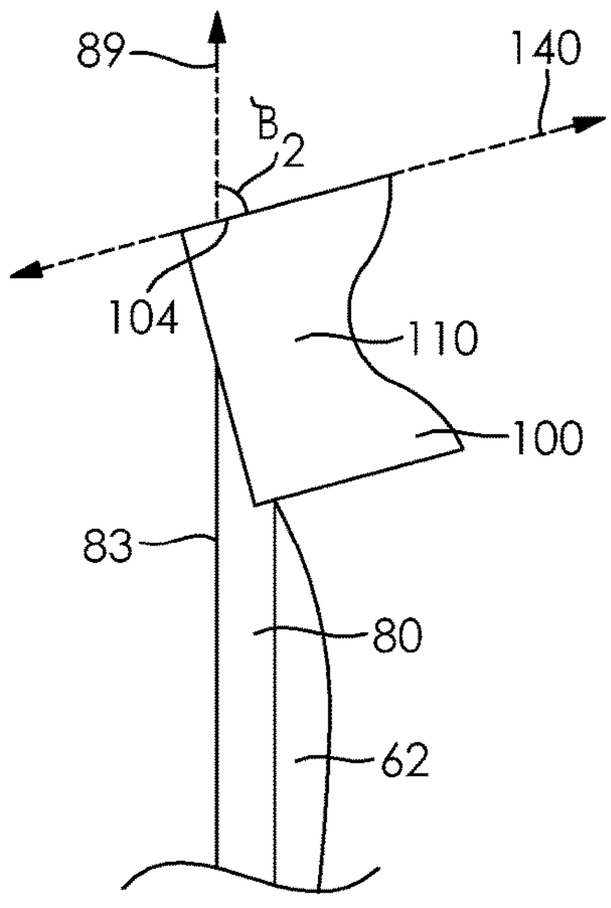


FIG. 7A

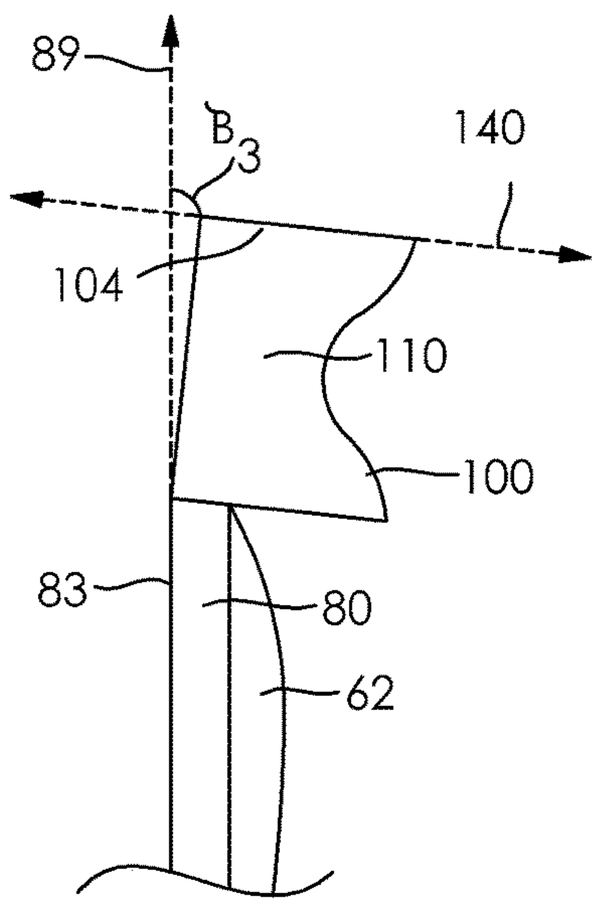


FIG. 7B

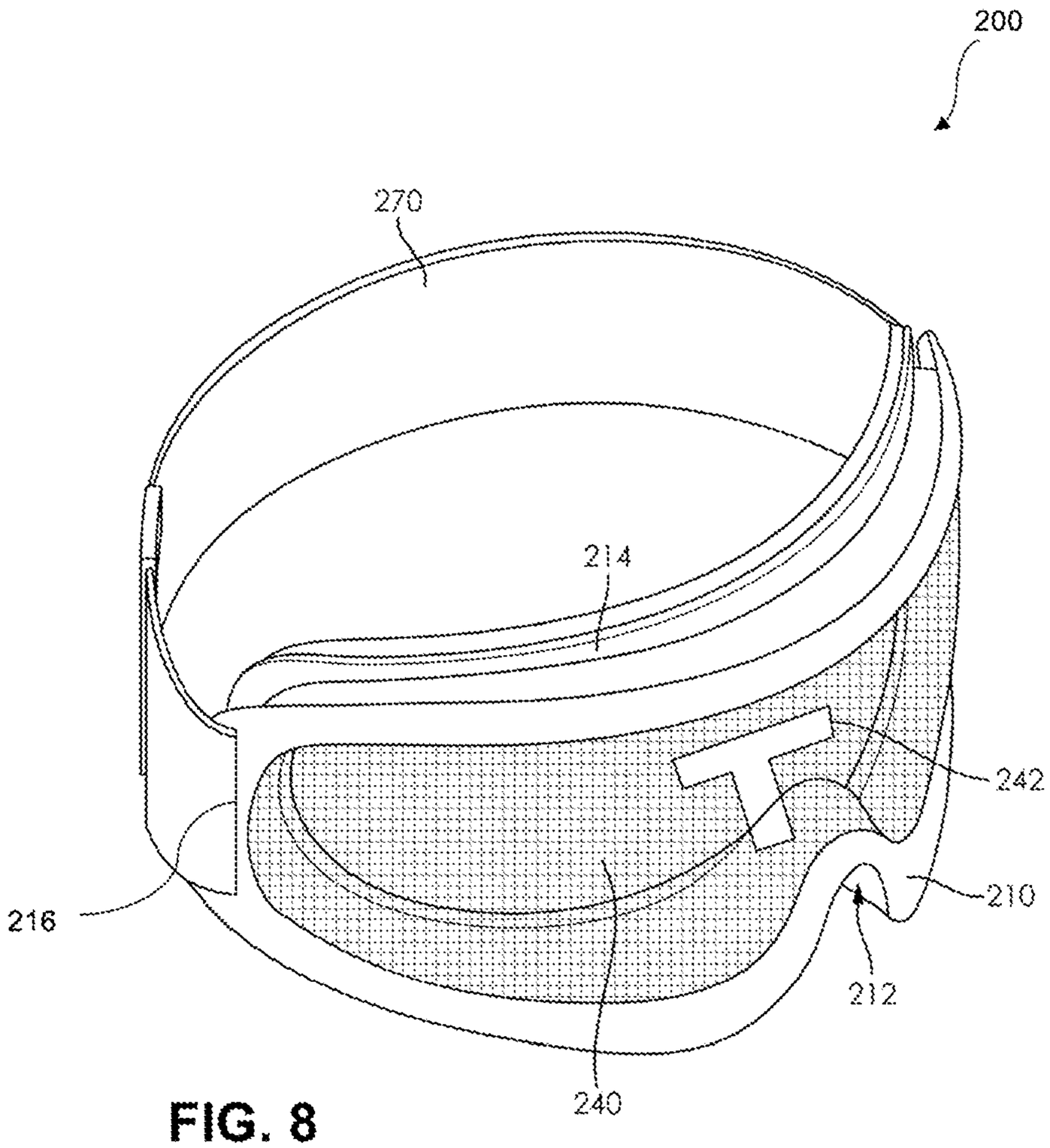


FIG. 8

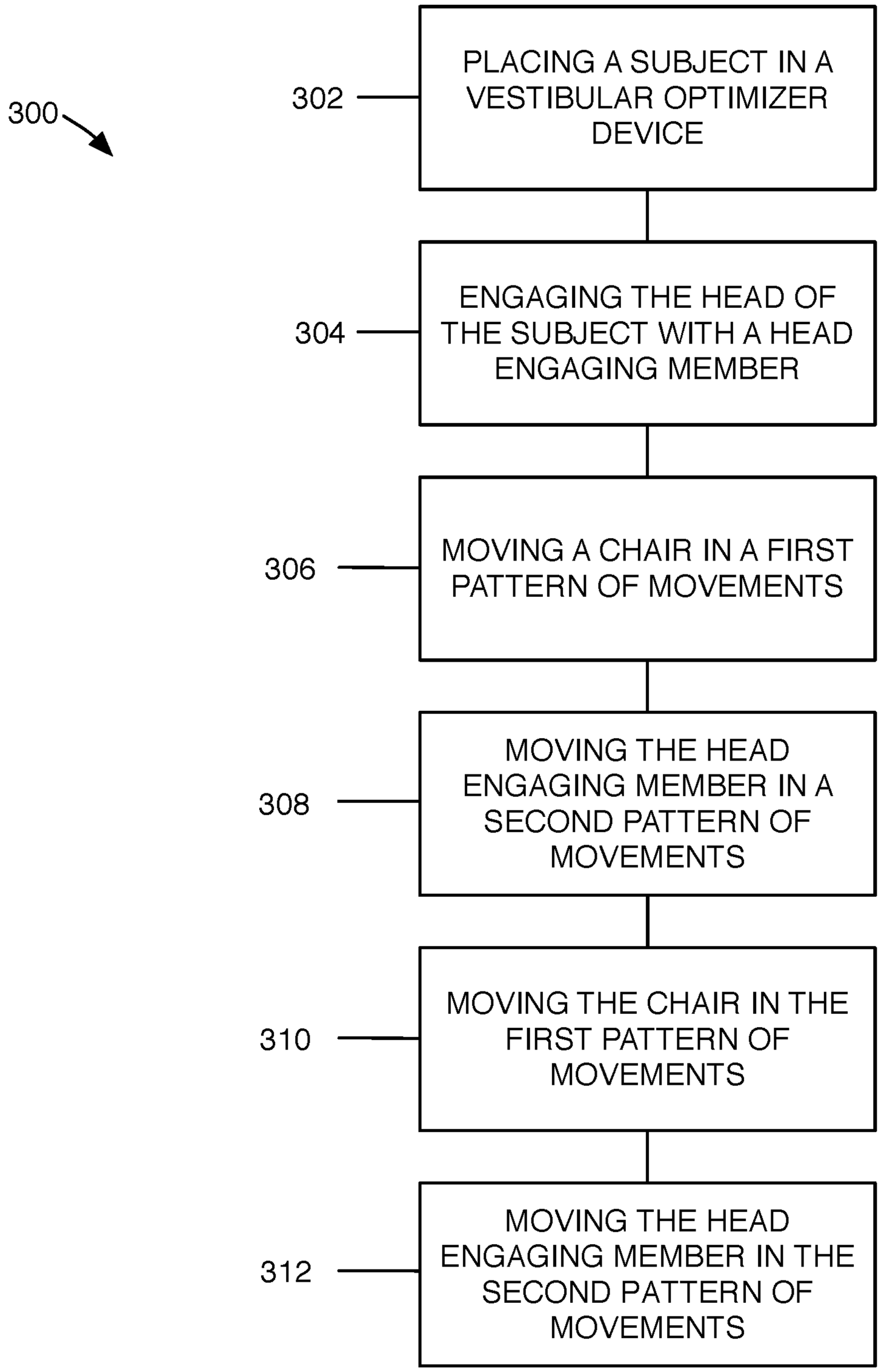

300
302
PLACING A SUBJECT IN A VESTIBULAR OPTIMIZER DEVICE
304
ENGAGING THE HEAD OF THE SUBJECT WITH A HEAD ENGAGING MEMBER
306
MOVING A CHAIR IN A FIRST PATTERN OF MOVEMENTS
308
MOVING THE HEAD ENGAGING MEMBER IN A SECOND PATTERN OF MOVEMENTS
310
MOVING THE CHAIR IN THE FIRST PATTERN OF MOVEMENTS
312
MOVING THE HEAD ENGAGING MEMBER IN THE SECOND PATTERN OF MOVEMENTS

FIG. 9

VESTIBULAR OPTIMIZER DEVICES, SYSTEMS, AND METHODS

FIELD

The disclosure relates to the field of vestibular optimizer devices, systems, and methods. More particularly, the disclosure relates to vestibular optimizer devices, systems, and methods designed to reduce the effects of disruptions to normal functioning of the vestibular system.

BACKGROUND

The vestibular system acts as a mechanism to maintain balance of an individual by monitoring the motion of the head and stabilizing the eyes relative to the surrounding environment. The vestibular system includes various organs disposed within the inner ear that sense movement and acceleration of the head in various directions.

A healthy vestibular system supplies the brain stem reliable information regarding spatial orientation, including information regarding the spatial orientation of the head. Normal functioning of the vestibular system can be disrupted, however, leading to transmission of inaccurate or unreliable information to the brain stem. A number of factors can contribute to such disruption, including several age-related factors. For example, an acoustic neuroma may grow on the vestibule-cochlear nerve. Contact between inner ear organs and various other bodies, including loose debris and skin (cholesteatoma) and bone growths (otosclerosis) can also disrupt the vestibular system. Moreover, many diseases and conditions can have a negative impact on the functioning of the vestibular system, including Meniere's disease, migraine associated vertigo, and various autoimmune diseases.

No matter the cause, disruptions to normal functioning of the vestibular system frequently have lifestyle-changing impact on the individual. These disruptions typically lead to spatial disorientation, which is the sensation of not knowing where one's body is in relation to one or both of the horizontal and vertical planes. Affected individuals are often forced to limit their movement and can become physically ill while disoriented.

Disruptions to normal vestibular function are common. One study indicates that as many as thirty-five percent of United States adults aged 40 years or older have experienced at least some type of vestibular dysfunction. (Agrawal, Y., et al., "Disorders of balance and vestibular function in US adults," Arch. Intern. Med. 2009; 169 (10): 938-44.)

Not surprisingly, the art includes a number of approaches to treating disruptions to normal vestibular function. For example, several approaches for stimulating the vestibular system include moving a subject in a particular physical pattern, whether horizontally, vertically, or rotationally. These approaches typically refrain from moving the affected individual, opting instead to move an apparatus (such as a chair, stool, or platform) on which the subject rests. These approaches aim to move the head in concert with the body and avoid movement of the head and/or neck independently of the body. U.S. Pat. No. 8,702,631 to Maher for VESTIBULAR STIMULATION SYSTEMS AND METHODS describes an example that follows this treatment approach

Despite this and other examples, a need exists for improved vestibular optimizer devices, systems, and methods.

BRIEF SUMMARY OF SELECTED EXAMPLES

Various example vestibular optimizer devices, systems, and methods are described and illustrated herein.

An example vestibular optimizer device configured to administer vestibular stimulation to a subject having a head comprises a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements, and a head engaging member attached to the back of the chair and configured to engage said head of said subject, the head engaging member adapted to move in a second pattern of movements.

An example system configured to administer vestibular stimulation to a subject having a head comprises a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements, a head engaging member attached to the back of the chair and configured to engage the head of said subject, the head engaging member adapted to move in a second pattern of movements, and a goggle apparatus configured to be worn on said head of said subject, the goggle apparatus comprising a frame, a lens attached to the frame, and a strap attached to the frame and configured to engage said head.

An example method of administering vestibular stimulation to a subject having a head, comprises the steps of placing the subject in a vestibular optimizer device comprising a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements, and a head engaging member attached to the back of the chair and configured to engage the head of said subject, the head engaging member adapted to move in a second pattern of movements, engaging said head of the subject with the head engaging member, moving the chair in the first pattern of movements, and moving the head engaging member in the second pattern of movements.

Additional understanding of claimed vestibular optimizer devices, systems, and methods can be obtained by reviewing the detailed description of selected examples, below, with reference to the appended drawings.

DESCRIPTION OF FIGURES

FIG. **1** is a side view of a first example vestibular optimizer device.

FIG. **2** is a cross-sectional view of the vestibular optimizer device illustrated in FIG. **1** taken along line **2-2**.

FIG. **3** is a top view of the vestibular optimizer device illustrated in FIG. **1**.

FIG. **4** is a top view of the section of the vestibular optimizer device illustrated in FIG. **1** taken along line **4-4**.

FIG. **5** is a magnified perspective view of Area I of the vestibular optimizer device illustrated in FIG. **1** and shows the head of a subject engaged by the head engaging member.

FIG. **6** is a side view of Area I of the vestibular optimizer device illustrated in FIG. **1**. The head engaging member of the vestibular optimizer device is illustrated in a neutral position.

FIG. **7**A is a side view of Area I of the vestibular optimizer device illustrated in FIG. **1**. The head engaging member of the vestibular optimizer device is illustrated in an extended position.

FIG. **7**B is a side view of Area I of the vestibular optimizer device illustrated in FIG. **1**. The head engaging member of the vestibular optimizer device is illustrated in a flexed position.

FIG. **8** is a perspective view of a first example goggle apparatus.

FIG. **9** is a flowchart representation of an example method of administering vestibular stimulation to a subject having a head.

DETAILED DESCRIPTION OF SELECTED EXAMPLES

The following detailed description and the appended drawings describe and illustrate various example vestibular optimizer devices, systems, and methods. The description and illustration of these examples are provided to enable one skilled in the art to make and use vestibular optimizer devices and systems, and to perform related methods. They are not intended to limit the scope of the claims in any manner.

As used herein, the term "central longitudinal axis" refers to the axis that extends vertically through the planes containing the proximal end, the distal end, and the geometric center of the support member, and the seat and the base.

Each of FIGS. **1**, **2**, **3**, **4**, **5**, **6**, **7**A, and **7**B illustrates an example vestibular optimizer device **2** or one or more components thereof. The vestibular optimizer device **2** comprises chair **9** having a base **10**, a support member **30**, a seat **50**, a back **80**, and a head engaging member **100**.

The base **10** is substantially box-shaped and includes a proximal end **12** and a distal end **14**. The base **10** also defines a cavity **16** that is in fluid communication with a cavity opening **18** that is disposed on the proximal end **12** of the base **10**. The cavity **16** is configured to a house a motor, such as motor **20**, described below, and/or various components thereof. Various cavities may be defined by any portion of the base in other embodiments. A skilled artisan will be able to determine how to suitably configure one or more cavities, if desired, according to a particular example based on various considerations, including the specifications of the motor and whether one or more motors is housed within a particular cavity. In other example embodiments, the base may define zero, one, two, three, or more than three cavities and one or more of these cavities may define a cavity opening. In other example embodiments, the base may be configured to house zero, one, two, three, or more than three motors.

The motor **20** disposed within the base **10** is configured to control the movements of the chair **9** and the head engaging member **100**. These movements are described in greater detail below. The motor **20** is operably connected to each of a first control mechanism **22** and a second control mechanism **26**. The first control mechanism **22** comprises a first wire **23** that is connected to the motor **20** and a first control unit **24**. The first wire **23** extends through the cavity opening **18** defined by the base **10** and the support member opening (described below) of the support member **30** and connects the motor **20** to the first control unit **24**, which is disposed on the inner wall (described below) of the support member **30**. The first control unit **24** controls and effects the displacement of the support member **30** relative to the base **10**. The first control unit **24** also contains a first set of software instructions (not illustrated in the Figures) that communicates particular movements of the support member **30** to the motor **20**, which carries out these instructions. The first set of software instructions may provide various settings that correspond to particular movements of the support member that are effectuated through the motor.

The second control mechanism **26** comprises a second wire **25** that is connected to the motor **20** and a second control unit **28**. The second wire **25** extends through the cavity opening **18** defined by the base **10**, each of the support member openings (described below) defined by the support member **30**, through a support member (described below) defined by the seat **50** and back **80** of the chair **9**, and through a head engaging member opening (described below). The second wire **25** connects the motor **20** to the second control unit **28**, which is disposed on the inner wall (described below) of the head engaging member **100**. The second control unit **28** controls the rotational movement of the head engaging member **100** and movement of the head engaging member **100** towards and away from the base **10**. The second control unit **28** also contains a second set of software instructions (not illustrated in the Figures) that communicates particular movement of the head engaging member **100** to the motor **20**, which carries out these instructions. The second set of software instructions may provide various settings that correspond to particular movements of the head engaging member **100** that are effectuated through the motor.

The motor **20** is operably connected to a control pad (not illustrated in the Figures) that allows a user of the vestibular optimizer device **2** to control the movements of the head engaging member **100** and chair **9** by selecting various settings. The control pad controls the motor **20** wirelessly. A skilled artisan will be able to determine how to suitably configure the first and second control mechanisms, if desired, according to a particular example based on various considerations, including the specifications of the motor and the desired movements of the head engaging member and chair. In other example embodiments, the first control mechanism may be operably connected to a first motor and the second control mechanism may be operably connected to a second motor. In such an embodiment, the second motor may be disposed on or within any portion of the vestibular optimizer device, including within the head engaging member. In other example embodiments, the motor may be disposed within any portion of the chair, including within the support member, back, seat, and head engaging member. In other example embodiments, one or more of the motor, the chair, and the head engaging member may include a physically-attached control pad that allows a user to select particular movements of the head engaging member and chair.

In the illustrated embodiment, the support member **30** comprises an elongate and tubular shaft having a proximal end **32**, a distal end **34**, and a support member passageway **36** having a support member wall **38** extending from the proximal end **32** to the distal end **34**. The support member **30** is substantially cylindrical and extends from the base **10** to the seat **50**. The proximal end **32** of the support member defines a proximal opening **40** and the distal end **34** of the support member defines a distal opening **42**; the proximal opening **40** is in fluid communication with the distal opening **42**. The proximal opening **40** is in fluid communication with a support member (described below) defined by the seat **50** and back **80** and the distal opening **42** is in fluid communication with the cavity opening **18**, and, therefore, the cavity **16**, of the base **10**. The support member **30** is configured to house the first wire **23**, the second wire **25**, and

the first control unit **24**. The support member may have any shape, size, and configuration, however. A skilled artisan will be able to determine a suitable shape, size, and configuration for the support member according to a particular example based on various considerations, including the shapes, sizes, and configurations of the seat and the base. In other example embodiments, the support member may have any shape, including conical, pyramidal, and box. The support member may also be integrally formed with one or both of the base and seat on other example embodiments.

As described above, the support member **30** is configured such that it can be moved toward or away from the base **10**. More specifically, the proximal end **32** of the support member **30** can be moved both towards and away from the base **10** of the support member **30** via the motor **20** and the first control unit **24**. The seat **50**, due to its attachment to the support member **30**, is therefore moved toward and/or away from the base **10** in concert with the support member **30**. In this embodiment, a portion of the support member **30** may extend into the base **10** in order to move the support member **30**, and the proximal end **32**, in particular, amongst various positions relative to the base **10**. Accordingly, the distal end **34** of the support member **10** is disposed within the base **10** and extends through its cavity opening **18**. A skilled artisan will be able to determine how to suitably configure the support member according to a particular example based on various considerations, including the specifications of the first control unit and the desired displacement of the support member relative to the base. In various example embodiments, the proximal end of the support member may be displaced any distance from the proximal end of the base. Examples of suitable distances between the proximal end of the support member and the proximal end of the base include distances between about 1 inches and about 48 inches, distances between about 18 inches and about 36 inches, and distances between about 24 inches and about 32 inches.

The support member **30** is also configured to be rotatable based on instructions from the motor **20**, the first control unit **22**, and the control pad. As illustrated in FIG. **4**, the central longitudinal axis **31** may be disposed on a plane **33** that is orthogonal to a plane **35** that extends through the leg rest (described below) of the chair **9** and geometric center of the support member **30**. Each of the planes **33**, **35** is parallel to the plane (not illustrated in the Figures) that contains the upper surface **11** defined by the proximal end **12** of the base **10**. The support member **30** can rotate up to a first angle α_1 relative to the proximal end **12** of the base **10**; it can also rotate up to a second angle α_2 relative to the proximal end **12** of the base **10**. The first angle α**1** may be substantially opposite to the second angle α_2 relative to the plane **35**. However, in other example embodiments, the support member may be rotated to any degree. A skilled artisan will be able to determine how to suitably configure the rotational ability of the support member according to a particular example based on various considerations, including the specifications of the first control unit and the desired displacement of the support member relative to the base. In various example embodiments, the support member may rotate up to any angle in either direction relative to the proximal end of the base. Examples of suitable first angles include angles between about 0° and about 50°, angles between about 10° and about 40°, and angles between about 20° and about 30°. Examples of suitable second angles include angles between about 0° and about −50°, angles between about −10° and about −40°, and angles between about −20° and about −30°. In other example embodiments, the support member may be rotated 360° about its central longitudinal axis.

The chair **9** also includes a seat **50** and a back **80**. The seat **50** and back **80** are integrally formed and, cooperatively, are substantially L-shaped. The seat **50** includes a first end **51**, a second end **53**, a proximal end **55**, and a distal end **52** that forms a seat opening **54** that is in fluid communication with the proximal opening **40** and a passageway (not illustrated in the Figures) that contains the second wire **25** and extends through the seat **50** and the back **80**. The proximal end **55** is substantially opposite the distal end **52** and includes a first cushion **60** that is attached to the proximal end **55**. The first cushion **60** may be attached to the proximal end **55** via one or more adhesives, as is shown in the illustrated embodiment. The first cushion **60** is configured to provide comfort to a subject that is seated on the first cushion **60**. A skilled artisan will be able to determine how to suitably configure the seat according to a particular example based on various considerations, including the size and shape of the passageway and the desired comfort level of a subject. In other example embodiments, the chair may not contain a first cushion. In other example embodiments, the cushion may be attached to the seat via one or more mechanical attachment mechanisms. In other example embodiments, the seat may be formed separately from the back, rather than integrally formed with the back.

Attached to the first end **51** of the seat **50** is a leg rest **64**. The leg rest **64** provides an area for a subject using the chair **9** to place his or her legs. The leg rest **64** is integrally formed with a footrest **66**. The footrest **66** provides an area for a subject using the chair **9** to place his or her feet. The leg rest **64** may be attached to the seat **50** via a mechanical attachment. A skilled artisan will be able to suitably configure the leg rest and the footrest, if desired, according to a particular example based on various considerations, including the distance between the base and the seat and height of the base. In other example embodiments, the chair may not include a leg rest or a footrest. In other example embodiments, the chair may include only a leg rest. In other example embodiments, the leg rest and the footrest may not be integrally formed; instead, the footrest may be attached to the leg rest via one or more adhesives and/or mechanical attachments. In other example embodiments, one or both of the leg rest and footrest may be extendable.

Also attached to the seat **50** are first and second arm rests **70**, **74**. The first and second arm rests **70**, **74** are substantially similar in shape and size and are each attached to a perimeter **59** of the seat **50**. The first armrest **70** includes a mounted portion **71**, which is attached to the seat via a mechanical attachment (not illustrated in the Figures), an arm bar **72**, and a grip **73**. As illustrated in FIG. **1**, the grip **73** is threaded to allow for a subject to more easily hold the grip **73**. The mounted portion **71** and arm bar **72** are substantially T-shaped. The second armrest **74** includes a mounted portion **75**, which is attached to the seat via a mechanical attachment (not illustrated in the Figures), an arm bar **76**, and a grip **77**. The grip **77** is threaded to allow for a subject to more easily hold the grip **77**. The mounted portion **75** and arm bar **76** are substantially T-shaped. A skilled artisan will be able to suitably configure the first and second arm rests, if desired, according to a particular example based on various considerations, including the shapes and sizes of the seat and the back. In other example embodiments, the first and second armrests may be integrally formed with the seat and/or back. In other example embodiments, the first and second armrests may be attached to the seat and/or back via one or more

adhesives. In other example embodiments, the chair may include zero or one armrest. In other example embodiments, one or more of the armrests may be extendable.

The back **80** includes a first end **81**, a second end **83**, a distal end **82**, and a proximal end **85** that forms a back opening **84** that is in fluid communication with the head engaging member opening (described below) and a passageway (not illustrated in the Figures) that contains the second wire **25** and extends through the seat **50** and the back **80**. The first end **81** is substantially opposite the second end **83** and includes a second cushion **62** that is attached to the first end **81**. The second cushion **62** may be attached to the first end **81** via one or more adhesives, as is shown in the illustrated embodiment. The second cushion **62** is configured to provide comfort to a subject whose back will rest on the second cushion **62**. A skilled artisan will be able to determine how to suitably configure the back according to a particular example based on various considerations, including the size and shape of the seat and the desired comfort level of a subject. In other example embodiments, the chair may not contain a second cushion. In other example embodiments, the cushion may be attached to the back via one or more mechanical attachment mechanisms.

The head engaging member **100** includes a main body **102**, a proximal end **104**, and a distal end **106**, a first end **108**, and a second end **109**. The main body **102** is comprised of a first side panel **110**, a second side panel **120**, and a base **130** disposed between the first side panel **110** and the second side panel **120**. The head engaging member **100** also includes an adjustable headband **150**. The head engaging member **100** is attached to the back **80** of the chair **9**.

As illustrated in FIG. **3**, the proximal end **104** of the main body **102** is substantially U-shaped. As FIG. **5** shows, the first side panel **110** is configured to contact the right side of a subject's **4** head **5**, while the second side panel **120** is configured to contact the left side of a subject's **4** head **5**. The first and second side panels **110**, **120** are configured to engage the head **5** of the subject **4** and keep the head **5** from moving independent from the movement of the head engaging member **100**, as instructed by the second control mechanism **24**, the motor **20**, and the control pad. The first and second side panels **110**, **120** and the base **130** are comprised of a material that will not damage or injure a subject's **4** head **5**. The main body may have any shape in other embodiments, however. A skilled artisan will be able to determine a suitable shape for the main body according to a particular example based on various considerations, including the size and shape of the back and the firmness with which the head should be held in place. In other example embodiments, the head engaging member can have any shape, including semi-conical, semi-cylindrical, and V-shaped. In other example embodiments, the head engaging member may comprise a board that does not include first and second side panels.

The head engaging member **100** includes an adjustable headband **150** that is attached to an inner wall **132** of the base **130** and provides additional stability to the head **5** of a subject **4**, as shown in FIG. **5**. The adjustable headband **150** is configured to surround at least a portion of the head **5** of a subject **4** and maintain the head **5** within its proper position. The adjustable headband **150** includes a cord **152** and an adjustment mechanism (not illustrated in the Figures), which allows the cord **152** to be tightened about a head **5**. The adjustable headband **150** is attached to the inner wall **132** via a mechanical attachment (not illustrated in the Figures). A skilled artisan will be able to determine how to configure the adjustable headband, if desired, according to a particular example based on various considerations, including the size and shape of the main body of the head engaging member. In other example embodiments, the adjustable headband may not be adjustable. In other example embodiments, the adjustable headband may be attached via one or more adhesives to any portion of any of the base, the first side panel, and/or the second side panel of the head engaging member.

As described above, the head engaging member **100** houses a second control mechanism **24** that provides instructions to the head engaging member **100** indicating direction and degree of movement. In the illustrated embodiment, the proximal end **104** of the main body **102** has at least two primary directions of movement: movement towards and away from the seat **50** and rotational movement.

FIGS. **6** and **7** best illustrate movement of the head engaging member **100** towards and away from the seat **50**. The proximal end **104** of the main body **102** of the head engaging member **100** is disposed on a first plane **140** that is substantially parallel to the plane (not illustrated in the Figures) on which the proximal end **12** of the base **10** is disposed. When the head engaging member **100** is in the neutral position, as illustrated in FIG. **6**, the first plane **140** is set at a third angle **131** to the plane **89** on which the second end **83** of the back **80** is disposed. The plane **89** extends through the base **10** and is substantially parallel to a plane (not illustrated in the Figures) on which the first end **81** of the back **80** is disposed. In this embodiment, the first plane **140** is substantially orthogonal to the plane **89** when the head engaging member **100** is in the neutral position. However, when the head engaging member **100** is in the extended position, as illustrated in FIG. **7**A, the first plane **140** is set at a fourth angle β_2 to the plane **89** on which the second end **83** of the back **80** is disposed. Additionally, when the head engaging member **100** is in the flexed position, as illustrated in FIG. **7**B, the first plane **140** is set at a fifth angle β_3 to the plane **89** on which the second end **83** is disposed. Accordingly, in use, the head engaging member **100** may pivot both toward and away from the seat **50** and may pivot a head in each direction. In various example embodiments, the head engaging member may be angled to any degree. A skilled artisan will be able to determine how to suitably angle the first plane relative to the second plane according to a particular example based on various considerations, including the desired procedure of the vestibular optimizer device and the size and shape of the head engaging member. In various example embodiments, the head engaging member may have any angle relative to the back when it is in either of the neutral, extended, and flexed positions. Examples of suitable third angles include angles between about 80° and about 100°, angles between about 85° and about 95°, and angles between about 88° and about 92°. Examples of suitable fourth angles include angles between about 40° and about 90°, angles between about 50° and about 80°, and angles between about 60° and about 70°. Examples of suitable fifth angles include angles between about 90° and about 140°, angles between about 100° and about 130°, and angles between about 110° and about 120°.

As indicated above, the head engaging member **100** can also be rotated. The second end **109** is disposed on the same plane as the plane **89** on which the second end **83** of the back **80** is disposed. Additionally, the outer portion **114** of the first side panel **110** and the outer portion **124** of the second side panel **120** are disposed on third and fourth planes **145**, **146**, respectively, that form sixth and seventh angles χ_1, χ_2 to the plane **89** on which the second end **83** of the back **80** is disposed. In the illustrated embodiment, each of the sixth

and seventh angles χ_1, χ_2 may be 90° when the head engaging member is in the neutral position, described above; accordingly, the third and fourth planes **145**, **146** may be orthogonal to the plane **89** on which the second end **83** of the back **80** is disposed. The head engaging member **100** can be rotated from the neutral position to a first rotated position in which the outer portion **114** of the first side panel **110** is rotated away from the second armrest **74**. When in the first rotated position, the sixth angle χ_1 may no longer be 90°. Additionally, the head engaging member **100** can be rotated from the neutral position to a second rotated position in which the outer portion **124** of the second side panel **120** is rotated away from the first armrest **70**. When in the second rotated position, the seventh angle χ_2 may no longer be 90°. A skilled artisan will be able to determine how to suitably angle the head engaging member relative to the chair according to a particular example based on various considerations, including the desired procedure of the vestibular optimizer device and the size and shape of the head engaging member. In various example embodiments, either of the outer portions of first and second side panels may have any angle relative to the back when it is in either of the first and second rotated positions. Examples of suitable sixth angles include angles between about 0° and about 50°, angles between about 10° and about 40°, and angles between about 20° and about 30°. Examples of suitable seventh angles include angles between about 0° and about −50°, angles between about −10° and about −40°, and angles between about −20° and about −30°.

FIG. **8** illustrates a goggle apparatus **200** configured to be worn on the head of a subject. The goggle apparatus **200** comprises a frame **210**, a lens **240**, and a strap **270**.

The frame **210** is elongate, curved, and designed to cover both eyes of a subject. The frame **210** includes a cutout **212** designed to abut the nose of a subject. The frame **210** is configured to engage the lens **240** and hold the lens **210** within a channel (not illustrated in the Figures) that extends around the interior portion (not illustrated in the Figures) of the frame **210**. The frame **210** also includes a first slot **216** configured to engage the strap **270** and a second slot (not illustrated in the Figures) configured to engage the strap **270**. The strap **270** is inserted through the first **216** and second slots and is configured to be worn around a subject's head. The strap **270** is adjustable and can be tightened or loosened based on an individual subject's head size and shape. Optionally, the frame **210** may further include a cushioned portion **214** configured to contact the head of a person. The cushioned portion **214** provides comfort to a wearer of the goggle apparatus **200**. The frame may have any size, shape, and configuration, however. A skilled artisan will be able to determine a suitable size, shape, and configuration for the goggle apparatus according to a particular example based on various considerations, including the size, shape, and configuration of the head engaging member. In other example embodiments, the frame may be integrally formed with the lens. In other example embodiments, the frame may not include a cushioned portion and/or a strap.

The lens **240** is substantially opaque and is attached to the frame **210**. The opacity of the lens **240** is illustrated by the pattern shown on the lens **240** in FIG. **8**. More specifically, the lens **240** is configured to be attached to the frame **210** within its channel. The lens **240** may be comprised of any material, including plastic or a metal, and includes a stimulus **242** on which the subject will concentrate when the goggle apparatus **200** is in use, described below. Thus, when a subject is using the goggle apparatus **200**, he or she will, primarily, be able to see the stimulus **242**. Therefore, the non-stimulus portions of the lens **240** may be substantially opaque. Though the stimulus **242** is T-shaped in this embodiment, he stimulus may comprise any number, letter, symbol, figure, drawing, combination thereof, and/or other design. A skilled artisan will be able to determine a suitable size, shape, and configuration for the lens and the stimulus according to a particular example based on various considerations including the procedure with which the goggle apparatus will be used. In other example embodiments, the lens may be partially opaque, partially transparent, completely transparent, and/or completely opaque. In other example embodiments, the lens may include zero, one, two, three, or more than three stimuli and the one or more stimuli may have any shape, size, and configuration.

The goggle apparatus **200** is used in conjunction with the vestibular optimizer device **2** to form a vestibular optimizer system (not illustrated in the Figures). The vestibular optimizer system comprises both the vestibular optimizer device **2** and the goggle apparatus **200** and functions to treat vestibular imbalances, afflictions, and/or diseases. The goggle apparatus **200** is worn by a subject and forces the subject to concentrate on a particular stimulus, such as stimulus **242**, while the chair **9** and head engaging member **100** of the vestibular optimizer device **2** manipulate the subject's head and body. Using a goggle apparatus **200** with an opaque lens **240** is advantageous because it focuses a subject's vision on the stimulus while their head and/or body is rotated, adjusted, and/or moved relative to the base **10** of the chair **9**. Sole focus on the stimulus **242** improves the functioning of the vestibular optimizer device **2** by orienting the head in a particular configuration, which has been proven to reduce vestibular system performance. Accordingly, the goggle apparatus **200** is specifically configured for use with the vestibular optimizer device **2**.

FIG. **9** is a flowchart representation of an example method **300** for administering vestibular stimulation to a subject having a head. Performance of this method **300** results in stimulation of the vestibular system of a subject.

An initial step **302** comprises placing the subject in a vestibular optimizer device, such as the vestibular optimizer device **2** described above. Accordingly, the vestibular optimizer device comprises a chair **9** and a head engaging member **100**. The chair **9** may move rotationally, described above, in which the support member **30**, and thus the seat **50**, rotate about the central longitudinal axis **31** of the support member **30**. The chair **9** also may be displaced relative to the base **10**, in which the seat **50** of the chair **9** moves toward or away from the base **10**, as described above.

Additionally, as described above, the head engaging member **100** includes a neutral position and may be capable of being transitioned into one or more of an extended position, a flexed position, a first rotated position, and a second rotated position. Any suitable vestibular optimizer device may be used to perform this step, however. A skilled artisan will be able to determine a suitable vestibular optimizer device for use for this step according to a particular example based on various considerations, including the particular vestibular deficiency the performer of this step wishes to treat and the size and shape of the subject. In other example embodiments, the chair may move rotationally, but not be displaced relative to the base; it may also be displaced relative to the base, but not move rotationally in other example embodiments. In other example embodiments, the head engaging member may include neutral, extended, and flexed positions, but not include first and second rotated positions. Additionally, in other example embodiments the

head engaging member may include neutral, first, and second rotated positions, but not flexed and/or extended positions.

Another step **304** comprises engaging the head of the subject with the head engaging member **100**. In this embodiment, the head of the subject is in contact with one or more of the first side panel **110**, the second side panel **120**, and the base **130** of the head engaging member **100**. The head of the subject may also be secured by the adjustable headband **150** of the head engaging member **100**. Securing the head of the subject with the adjustable headband **150** is optional, however.

Another step **306** comprises moving the chair **9** in a first pattern of movements. Example first patterns of movements are described below.

Another step **308** comprises moving the head engaging member **100** in a second pattern of movements. Example second patterns of movements are described below.

Optionally, another step **310** may be performed. Step **310** comprises repeating the movement of the chair **9** in a first pattern of movements that is described in step **306**.

Optionally, another step **312** may be performed. Step **312** comprises repeating the movement of the chair **9** in a second pattern of movements that is described in step **308**.

Any of steps **306**, **308**, **310**, and **312** may be performed in any order. Additionally, various methods exist in which fewer than each of steps are performed. A skilled artisan will be able to determine which of these steps may be performed and their sequence according to a particular example based on various considerations, including the particular vestibular deficiency the performer of this step wishes to treat and the size and shape of the subject. In other example embodiments, only steps **306** and **308** are performed. In other example embodiments, only steps **308** and **310** are performed. In other example embodiments, the subject of the method may wear a goggle apparatus, such as goggle apparatus **200**. In other example embodiments, one or more of steps **306**, **308**, **310**, and **312** may be performed between about 1 time and about 20 times, between about 3 and about 12 times, and about 5 and about 8 times.

It is noted that it is considered advantageous to complete the method **300** in the order illustrated and described. However, any order is considered suitable.

EXAMPLES

Below are examples of first patterns of chair movements and second patterns of head engaging member movements. Performance of a first pattern of movements and a second pattern of movements comprise a sequence.

Example 1—First Sequence

The first sequence begins with placing the head engaging member in the extended position. In this example sequence, the fourth angle **132**, which is described above, is approximately 40°. Next, the seat of the chair is raised relative to and away from the base. In this example sequence, the chair is raised approximately 36 inches away from the base. Once the chair has been moved, the head engaging member is transitioned from the extended position to the neutral position; accordingly, the third angle β_1, which is described above, is approximately 90° when in the neutral position. Next, the seat of the chair is lowered relative to and toward the base. In this example sequence, the chair is lowered approximately 36 inches toward the base. The first sequence is then repeated five times.

It is noted that the head engaging member may be placed in the flexed position, in addition to or instead of in the extended position, in other examples.

Example 2—Second Sequence

The second sequence begins with placing the head engaging member in the extended position. In this example sequence, the fourth angle β_2, which is described above, is approximately 40°. Additionally, when this sequence is performed with a subject, the subject may be wearing a goggle apparatus, such as goggle apparatus **200** described above, and may be told to focus on a stimulus, such as stimulus **242**. Next, the seat of the chair is raised relative to and away from the base. In this example sequence, the chair is raised approximately 36 inches away from the base. While the seat is moving away from the base, the head engaging member is transitioned from the extended position to the neutral position; accordingly, the third angle β_1, which is described above, is approximately 90° when in the neutral position. The head engaging member begins transitioning to the neutral position once the chair is approximately 18 inches away from the base and is fully placed in the neutral position once the hair is approximately 36 inches from the base. The head engaging member is then placed in the extended position and, in this example sequence, the fourth angle β_2 is approximately 40°. Next, the seat of the chair is lowered relative to and toward the base. In this example sequence, the chair is lowered approximately 36 inches toward the base. The head engaging member is then placed in the neutral position. The second sequence is then repeated five times.

It is noted that the head engaging member may be placed in the flexed position, in addition to or instead of in the extended position, in other examples.

Example 3—Third Sequence

The third sequence begins with placing the head engaging member in the extended position. In this example sequence, the fourth angle β_2, which is described above, is approximately 40°. Additionally, when this sequence is performed with a subject, the subject may be wearing a goggle apparatus, such as goggle apparatus **200** described above, and may be told to focus on a stimulus, such as stimulus **242**. Next, the seat of the chair is raised relative to and away from the base. In this example sequence, the chair is raised approximately 36 inches away from the base. While the seat is moving away from the base, the head engaging member is transitioned from the extended position to the neutral position; accordingly, the third angle β_1, which is described above, is approximately 90° when in the neutral position. The head engaging member begins transitioning to the neutral position once the chair is approximately 6 inches away from the base and is fully placed in the neutral position once the seat is approximately 36 inches from the base. The head engaging member is then placed in the extended position and, in this example sequence, the fourth angle β_2 is approximately 40°. Next, the seat of the chair is lowered relative to and toward the base. In this example sequence, the chair is lowered approximately 36 inches toward the base. The head engaging member then begins transitioning to the neutral position once the chair has moved approximately 6 inches toward the base and is fully placed in the neutral position once the seat has been lowered 36 inches toward the base. The third sequence is then repeated five times.

It is noted that the head engaging member may be placed in the flexed position, in addition to or instead of in the extended position, in other examples.

Example 4—Fourth Sequence

The fourth sequence begins with placing the head engaging member in the neutral position. When this sequence is performed with a subject, the subject may be wearing a goggle apparatus, such as goggle apparatus **200** described above, and may be told to focus on a stimulus, such as stimulus **242**. Next, the support member and, therefore, the seat of the chair is rotated to a first angle α_1 relative to the proximal end of the base, as described above. In this example, the first angle α_1 is approximately 50°. Once the chair has been rotated, the head engaging member is transitioned from the neutral position to the first rotated position. In this example, the sixth angle χ_1, described above, is approximately 50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The chair is then rotated to its original position. The head engaging member is then placed in the neutral position. The fourth sequence is then repeated five times.

It is noted that the fourth sequence also may be performed such that the seat of the chair is rotated to a second angle α_2 relative to the proximal end **12** of the base **10**. In such an example, the second angle α_2 is approximately −50°. Additionally, the head engaging member may be rotated to the second rotated position and to a seventh angle χ_2, described above, that is approximately −50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The head engaging member may also be placed in the flexed and/or extended positions during this sequence.

Example 5—Fifth Sequence

The fifth sequence begins with placing the head engaging member in the neutral position. When this sequence is performed with a subject, the subject may be wearing a goggle apparatus, such as goggle apparatus **200** described above, and may be told to focus on a stimulus, such as stimulus **242**. Next, the support member and, therefore, the seat of the chair is rotated to a first angle α_1 relative to the proximal end of the base, as described above. In the Fourth Sequence, described above, the first angle α_1 is approximately 50°; in this example, the first angle α_1 is approximately 20°. Once the chair has been rotated approximately 15°, the head engaging member is transitioned from the neutral position to the first rotated position. In this example, the sixth angle χ_1, described above, is approximately 50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The chair is then rotated to its original position. The head engaging member is then placed in the neutral position. The fifth sequence is then repeated five times.

It is noted that the fifth sequence also may be performed such that the seat of the chair is rotated to a second angle α_2 relative to the proximal end **12** of the base **10**. In such an example, the second angle α_2 is approximately −20°. Additionally, the head engaging member may be rotated to the second rotated position and to a seventh angle χ_2, described above, that is approximately −50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The head engaging member may also be placed in the flexed and/or extended positions during this sequence.

Example 6—Sixth Sequence

The sixth sequence begins with placing the head engaging member in the neutral position. When this sequence is performed with a subject, the subject may be wearing a goggle apparatus, such as goggle apparatus **200** described above, and may be told to focus on a stimulus, such as stimulus **242**. Next, the support member and, therefore, the seat of the chair is rotated to a first angle α_1 relative to the proximal end of the base, as described above. In the Fourth Sequence, described above, the first angle α_1 is approximately 50°; in this example, the first angle α_1 is approximately 10°. Once the chair has been rotated approximately 5°, the head engaging member is transitioned from the neutral position to the first rotated position. In this example, the sixth angle χ_1, described above, is approximately 50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The chair is then rotated to its original position. The head engaging member is then placed in the neutral position. The sixth sequence is then repeated five times.

It is noted that the sixth sequence also may be performed such that the seat of the chair is rotated to a second angle α_2 relative to the proximal end **12** of the base **10**. In such an example, the second angle α_2 is approximately −10°. Additionally, the head engaging member may be rotated to the second rotated position and to a seventh angle χ_2, described above, that is approximately −50° relative to the plane **89** on which the second end **83** of the back **80** is disposed. The head engaging member may also be placed in the flexed and/or extended positions during this sequence.

All components of the vestibular optimizer devices and systems can be made from any suitable material. Non-limiting examples of suitable materials include one or more metals, one or more plastics, and some combination of metal and plastic.

Those with ordinary skill in the art will appreciate that various modifications and alternatives for the described and illustrated embodiments can be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are intended to be illustrative only and not limiting as to the scope of the invention, which is to be given the full breadth of the appended claims and any and all equivalents thereof.

I claim:

1. A vestibular optimizer device configured to administer vestibular stimulation to a subject having a head, comprising:

a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements;

a head engaging member attached to the back of the chair and configured to engage said head of said subject, the head engaging member having a main body comprising a first side panel, a second side panel, a base disposed between the first side panel and the second side panel, and an adjustable headband attached to the base, at least one other axis parallel to the central longitudinal axis independent of movement of the chair about the central longitudinal axis and adapted to move in a second pattern of movements;

a motor;

a first control unit operably connected to the motor, the first control unit configured to control movement of the support member of the chair; and

a second control unit operably connected to the motor, the second control unit configured to control movement of the head engaging member.

2. The vestibular optimizer device of claim **1**, wherein the chair and the head engaging member can move contemporaneously.

3. The vestibular optimizer device of claim **1**, wherein the motor is disposed within the base of the chair.

4. The vestibular optimizer device of claim **1**, further comprising a first armrest attached to the seat of the chair.

5. The vestibular optimizer device of claim **4**, further comprising a second armrest attached to the seat of the chair.

6. The vestibular optimizer device of claim **5**, further comprising a leg rest attached to the seat of the chair.

7. The vestibular optimizer device of claim **1**, wherein the support member comprises a shaft.

8. A system configured to administer vestibular stimulation to a subject having a head, comprising:

a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements;

a head engaging member attached to the back of the chair and configured to engage the head of said subject, the head engaging member having a main body comprising a first side panel, a second side panel, a base disposed between the first side panel and the second side panel, and an adjustable headband attached to the base, at least on other axis parallel to the central longitudinal axis independent of movement of the chair about the central longitudinal axis and adapted to move in a second pattern of movements;

a motor;

a first control unit operably connected to the motor, the first control unit configured to control movement of the support member of the chair;

a second control unit operably connected to the motor, the second control unit configured to control movement of the head engaging member; and

a goggle apparatus configured to be worn on said head of said subject, the goggle apparatus comprising a frame, a lens attached to the frame, and a strap attached to the frame and configured to engage said head.

9. The system of claim **8**, wherein the lens is able to display at least one stimulus.

10. The system of claim **9**, wherein the lens is at least partially opaque.

11. A method of administering vestibular stimulation to a subject having a head, comprising the steps of:

placing the subject in a vestibular optimizer device comprising a chair having a base, a seat, a back, and a support member, the support member extending from the base to the seat, comprising a central longitudinal axis, and being attached to the seat, the support member rotatable about the central longitudinal axis, the seat adapted to move toward and away from the base, the chair adapted to move in a first pattern of movements, a head engaging member attached to the back of the chair and configured to engage the head of said subject, the head engaging member having a main body comprising a first side panel, a second side panel, a base disposed between the first side panel and the second side panel, and an adjustable headband attached to the base, at least one other axis parallel to the central longitudinal axis independent of movement of the chair about the central longitudinal axis and adapted to move in a second pattern of movements, a motor, a first control unit operably connected to the motor, the first control unit configured to control movement of the support member of the chair, and a second control unit operably connected to the motor, the second control unit configured to control movement of the head engaging member; and

engaging said head of the subject with the head engaging member;

moving the chair in the first pattern of movements; and

moving the head engaging member in the second pattern of movements.

12. The method of claim **11**, wherein the moving the chair in the first pattern of movements step is performed before the moving the head engaging member in the second pattern of movements step.

13. The method of claim **11**, wherein the moving the chair in the first pattern of movements step is performed at the same time as the moving the head engaging member in the second pattern of movements step.

14. The method of claim **11**, wherein the step of moving the chair in the first pattern of movements is repeated.

15. The method of claim **11**, wherein the step of moving the head engaging member in the second pattern of movements is repeated.

* * * * *